Report No: ILETR120202
Revision: -
Total Pages: 23
Date: 02/02/12

INITIAL MAKE-UP TORQUE

SSP DUOLOK® VS. PARKER-HANNIFIN A-LOK® VS. SWAGELOK® TUBE FITTINGS

ENGINEERING TECHNICAL REPORT

TABLE OF CONTENTS

1.0	Introduction		/05
	1.1	Scope	/05
	1.2	References	/05
	1.3	Test Specimen Description	/05
	1.4	Summary	/05
2.0	Test Procedures and Results		/06
	2.1	Initial Make-up Torque	/06
	2.2	Results	/07
3.0	Test Equipment and Instrumentation		/08
4.0	Quality Assurance Program		/08
5.0	Attachments		/10
	A.	Photographs	/10
	B.	Test Data	/11
	C.	Equipment	/23

SSP INTRODUCTION

Parker A-LOK® Instrumentation Tube Fittings are designed as leak-free connections for process, power, and instrumentation applications. The Parker A-LOK® twin ferrule fitting consists of four precision engineered parts designed to provide secure leak-proof joints capable of satisfying high pressure, vacuum and vibration applications. Parker Instrumentation Tube Fittings are supplied complete and ready to use. The front ferrule swages onto the tube as it moves down the body seat creating a pressure/vacuum-tight seal on both tube and body by the interface pressure and surface finish of mating components. The Parker Suparcase back ferrule then moves inwards in the cone of the front ferrule, forming into the tube and creating a strong mechanical hold on the tube. Parker A-LOK® tube fittings do not twist the tubing during installation.[1]

Swagelok® two-ferrule tube fittings are designed to provide consistent, predictable, leak-free connections for fluid systems over a range of applications. An advanced geometry back ferrule was developed to perform on harder, higher pressure tubing while maintaining or reducing installation effort and compatibility with the original tube fitting design. During installation, the nut is turned to drive the back ferrule into the front ferrule to create a primary seal. The back ferrule then hinges radially inward to produce a consistent, firm grip.[2]

In 1993, in response to continued customer requests for an alternative product offering in the Instrumentation marketplace, strategic plans were developed within SSP to design, manufacture and distribute American manufactured, Instrumentation quality tube fittings as a direct alternative to the registered trademark brands of Parker A-LOK® and Swagelok® Tube Fittings. Following an ISO 9001 design process pattern, the critical elements of design planning, including the detailed documentation of design inputs and outputs, occurred for the development of **Duolok®** tube fittings.

To accomplish the required design plan tasks of verification and validation, a specialized Technical Center was built within SSP. In addition to the exhaustive engineering calculations for confirmation of design conformance to industry standards and other engineering developed criteria, customized NIST traceable testing equipment was procured to allow comprehensive validation of design inputs.

In 1998, SSP Duolok brand tube fittings were offered to the marketplace as a direct alternative to Parker A-LOK® and Swagelok® two ferrule instrumentation tube fittings. Since then, millions of SSP Duolok tube fittings have been manufactured and installed throughout the world.

[1] Parker Instrumentation A-LOK® Tube Fittings catalog 4233, January 2003, pp 2-3
[2] Swagelok 316 Stainless Steel Swagelok® Tube Fittings with Advanced Geometry Back Ferrules catalog MS-06-16-E, October 2003, pp2-3

In 2010, SSP's Technical Center Laboratory was certified by A2LA to be compliant with the requirements of ISO/IEC 17025:2005 (A2LA Certificate No. 3030.01). This certification assures that results developed by SSP's Technical Center Laboratory meet the same standard of accuracy, independence and integrity as other certified third-party commercial laboratories. The scope of SSP's accreditation includes the following test methods:

Impulse Testing (ASTM F1387, A5)
Pneumatic Proof Test (ASTM F1387, A3)
Hydrostatic Proof Test (ASTM F1387, A4)
Flexural Fatigue Test (ASTM F1387, A6)
Tensile Test (ASTM F1387, A7)
Hydrostatic Burst Test (ASTM F1387, A8)
Rotary Flex Test (ASTM F1387, A10)
Hardness – Rockwell C, B & N (ASTM E18)
Hardness – Vickers (ASTM E384)

1.0 INTRODUCTION

This document's purpose is to report, in a published format for public review, a representative sampling of the **Duolok** tube fitting's actual performance results from Production Validation Tests. The performance results are measured against the Design Team's Approved Acceptance Criteria, which are based on meeting or exceeding the published and / or test-based performance of equivalent Parker A-LOK® and Swagelok® tube fittings.

1.1 SCOPE

Scope: This test report documents the results of performance testing for the 1/4", 3/8", 1/2", 3/4" and 1", SSP Duolok, Parker-Hannifin A-LOK, and Swagelok Tube Fittings. The samples were tested for initial make up torque in SSP's accredited Technical Center Laboratory.

1.2 REFERENCES

- SSP No. QM06, "SSP Tech Center Laboratory Quality Manual"
- ISO 17025, "General Requirements for the Competence of Testing and Calibration Laboratories"
- ISO 9001:2008, "Quality Management Systems – Requirements"
- ANSI/NCSL Z540-1, "Calibration Laboratories and Measuring and Test Equipment, General Requirements"
- ASTM F1387-99, "Standard Specification for Performance of Piping and Tubing Mechanically Attached Fittings"
- ISO 10012-1, "Quality Assurance Requirements for Measuring Equipment"
- MIL-STD-45662A, "Calibration System Requirements"

1.3 TEST SPECIMEN DESCRIPTION

This Technical Report lists the Validation Test that was performed, and the sections which follow describe the test and outline specific results. All products are manufactured at SSP to approved and controlled engineering documentation, to established process and quality procedures at every stage of manufacture, with fully calibrated quality and process instrumentation, using only certified and traceable materials. Tested products were selected randomly from normal production runs. Before and after test samples were retained for reference. All tubing used in testing meets applicable ASTM specifications, and has approved material and chemical certifications.

All product testing was conducted in SSP's accredited Technical Center Laboratory with laboratory equipment and instrumentation in current calibration. Trained personnel conducted tests by following approved, written test procedures. All test results were subjected to thorough engineering review and approval before internal publication.

1.4 SUMMARY

In every case **Duolok** test results met or exceeded the established Design Team's Acceptance Criteria for these products. As such, they also met or exceeded equivalent major competitive product performance, as measured in test data and / or reported in publications.

2.0 TEST PROCEDURES AND RESULTS
2.1: INITIAL MAKE-UP TORQUE TEST

Purpose: Test determines the torque necessary for the initial assembly of a tube, fitting body, back ferrule, front ferrule, and nut assembled together per standard assembly instructions. Fittings of a given size and brand are tested on various wall thicknesses (including minimum and maximum recommended wall) for each test product configuration.

Test Procedure: The tube fitting assembly is assembled with body and components of same brand to a 'finger-tight' position. The nut is then tightened to the manufacturers recommended number of turns for initial make-up. The torque required to achieve this initial make-up is recorded after every ¼ turn of the nut.

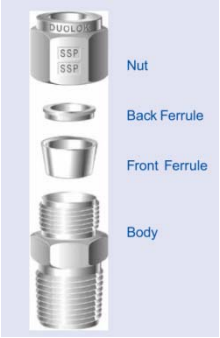

Figure 2.1.1 Initial Make-up Assembly Components

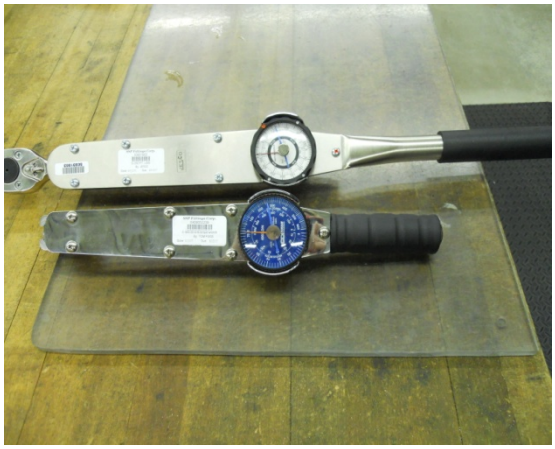

Figure 2.1.2 Initial Make-up Torque Test Equipment

Figure 2.1.3 Initial Make-up Torque Test Equipment

Acceptance Criteria: ***Preferred:*** The SSP tube fitting assembly achieves initial make-up position at a torque less than both Parker A-LOK and Swagelok Tube Fittings. ***Acceptable:*** The SSP tube fitting assemblies achieve initial make-up position at a torque equivalent (equal to or less than 115%) of Parker A-LOK and Swagelok Tube Fittings.

2.2: RESULTS

Average Initial Make-up Torque @ 1-1/4 turns (in·lbs)					
Fitting Size	Tubing Wall	SSP Duolok	Parker A-LOK	Swagelok Original BF	Swagelok Advanced Geometry BF
4	0.028	71	158	78	91[3]
4	0.035	81[3]	168	N/A	91[3]
4	0.065	117	224	125	143[3]
6	0.035	137	255	165	163
6	0.065	217	296[4]	255	202
8	0.035	213	383	N/A	223
8	0.049	196[4]	425	N/A	312[3]
8	0.083	308[4]	594	168	385
12*	0.049	46*[2]	57*	N/A	66*[3]
12*	0.065	48*[3]	73*[3]	N/A	70*[3]
12*	0.109	59*[2]	90*	N/A	68*[3]
16*	0.065	96*	126*	N/A	120*[1]
16*	0.120	139*	166*	158*	133*[1]

All results consist of at least 20 samples and units of in·lbs unless otherwise noted
* - Torque value shown are in ft·lbs
1 – Average of 3 samples
2 – Average of 4 samples
3 – Average of 6 samples
4 – Average of 10 samples

Table 2.2.1 Initial Make-up Torque Data Summary

3.0: TEST EQUIPMENT AND INSTRUMENTATION

Calibration and Standardization:

1. Description: Torque Wrench
   Range: 0-600 in*lbs
   ID #: 409052239
   Calibration Date: 03/02/2011 Due: 03/02/2012

2. Description: Torque Wrench
   Range: 0-250 ft*lbs
   ID #: 50931863
   Calibration Date: 09/02/2011 Due: 09/02/2012

4.0: QUALITY ASSURANCE PROGRAM

The preceding lists the major Validation Tests that were performed, and the sections which follow describe the tests and outline specific results. All products manufactured at SSP are to approved and controlled engineering documentation, to established process and quality procedures at every stage of manufacture, with fully calibrated quality and process instrumentation, using only certified and traceable materials. Tested products were selected randomly from documented normal production runs. Before and after test samples were retained for reference. All tubing used in testing meets applicable ASTM specifications, and has approved material and chemical certifications.

All SSP tests conducted on products are with laboratory equipment and instrumentation in current calibration in an ISO 17025 accredited laboratory. Trained personnel conducted tests by following approved, written test procedures. All test results were subjected to thorough engineering review and approval before internal publication.

ASTM Material Standards		
Standard	**Material Shape**	**Description**
A 182	Forged Fittings, Parts	Standard Specification for Forged or Rolled Alloy – Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
A 276	Bars	Standard Specification for Stainless Steel Bars and Shapes
A 479	Bar, Shapes	Standard Specification for Stainless Steel Bars and Shapes for use in Boilers and other Pressure Vessels
B 16	Bar, Shapes	Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for use in Screw Machines
B 124	Bar, Shapes	Standard Specification for Copper and Copper Alloy Forging Rod, Bar and Shapes
B 453	Bar, Shapes	Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Rod
A 179	Tube	Standard Specification for Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes
A 213	Tube	Standard Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater and Heat-Exchanger Tubes
A 249	Tube	Standard Specification for Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes
A 269	Tubing	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
B 68	Tube	Standard Specification for Copper Tube, Bright Annealed
B 75	Tube	Standard Specification for Seamless Copper Tube
B 88	Tube	Standard Specification for Seamless Copper Water Tube

Table 4.0.1

Applicable Codes and Standards	
Section	**Test Description**
ANSI/ASME B 31.1	Power Piping Code
ANSI/ASME B 31.3	Process Piping Code
ANSI/ASME BPV Section VIII	Boiler & Pressure Vessel Code
ISO 7257	Aircraft – Hydraulic tubing joints and fittings – Rotary flexure test

Table 4.0.2

5.0: ATTACHMENTS

A. PHOTOGRAPHS

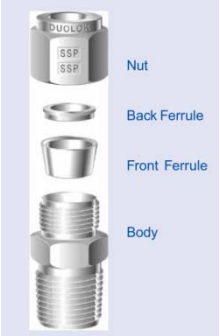

Figure 2.1.1 Initial Make-up Assembly Components

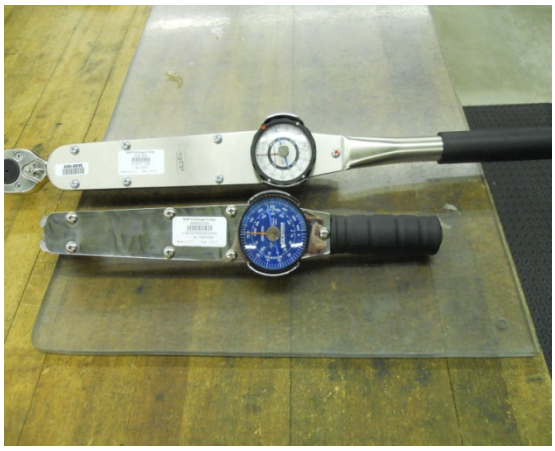

Figure 2.1.2 Initial Make-up Torque Test Equipment

Figure 2.1.3 Initial Make-up Torque Test Equipment

B. TEST DATA

Duolok Size 4; .028 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	10	15	20	30	65
2	17	32	44	53	73
3	15	30	39	53	73
4	17	30	39	49	72
5	18	30	39	54	70
6	16	34	49	62	80
7	19	36	51	61	75
8	17	28	37	48	64
9	16	28	39	58	71
10	18	31	43	60	78
11	18	29	43	54	66
12	16	32	45	58	71
13	18	29	39	52	66
14	18	34	45	58	82
15	17	29	40	50	58
16	19	33	46	58	75
17	19	33	43	55	67
18	19	32	44	60	75
19	16	28	39	54	67
20	18	36	58	62	79
No. Samples:	20	20	20	20	20
Largest:	19.00	36.00	58.00	62.00	82.00
Smallest:	10.00	15.00	20.00	30.00	58.00
Variation:	9.00	21.00	38.00	32.00	24.00
Average:	**17.05**	**30.45**	**42.10**	**54.45**	**71.35**

A-LOK Size 4; .028 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	30	65	90	130	150
2	30	65	120	140	170
3	40	100	150	180	210
4	40	85	130	140	155
5	20	50	90	100	130
6	30	60	105	130	160
7	30	65	110	145	170
8	30	60	100	130	160
9	50	100	160	190	220
10	20	60	85	90	125
11	35	70	110	120	140
12	20	45	60	85	110
13	20	50	80	105	140
14	30	55	100	155	200
15	30	70	120	130	150
16	20	40	75	115	135
17	30	65	110	140	155
18	20	60	100	120	140
19	30	70	120	145	170
20	35	65	110	135	165
No. Samples:	20	20	20	20	20
Largest:	50.00	100.00	160.00	190.00	220.00
Smallest:	20.00	40.00	60.00	85.00	110.00
Variation:	30.00	60.00	100.00	105.00	110.00
Average:	**29.50**	**65.00**	**106.25**	**131.25**	**157.75**

Original Swagelok Size 4; .028 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	15	27	41	57	71
2	17	38	55	66	80
3	16	36	52	70	83
4	15	40	60	70	81
5	15	30	65	70	80
6	13	30	60	70	92
7	15	30	70	70	85
8	17	31	46	60	68
9	15	30	46	68	75
10	17	31	45	66	90
11	12	25	41	59	75
12	14	29	46	55	80
13	14	27	40	58	79
14	16	33	47	60	70
15	14	31	47	58	74
16	14	32	48	58	75
17	14	27	43	55	71
18	12	28	46	65	90
19	15	30	40	54	68
20	17	40	55	64	73
No. Samples:	20	20	20	20	20
Largest:	17.00	40.00	70.00	70.00	32.00
Smallest:	12.00	25.00	40.00	54.00	68.00
Variation:	5.00	15.00	30.00	16.00	24.00
Average:	**14.85**	**31.25**	**49.65**	**62.65**	**78.00**

Advanced Geometry Swagelok Size 4; .028 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	20	40	65	80	90
2	15	30	50	70	90
3	20	40	65	90	100
4	20	50	80	95	100
5	20	40	55	70	80
6	20	40	55	75	85
No. Samples:	6	6	6	6	6
Largest:	20.00	50.00	80.00	95.00	100.00
Smallest:	15.00	30.00	50.00	70.00	80.00
Variation:	5	20	30	25	20
Average:	**19**	**40**	**62**	**80**	**91**

Duolok Size 4; .035 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	20	40	55	70	85
2	20	35	45	60	75
3	20	30	50	60	90
4	20	30	45	55	80
5	20	30	45	60	75
6	20	30	50	60	80
No. Samples:	6	6	6	6	6
Largest:	20.00	40.00	55.00	70.00	90.00
Smallest:	20.00	30.00	45.00	55.00	75.00
Variation:	0.00	10.00	10.00	15.00	15.00
Average:	**20.00**	**32.50**	**48.33**	**60.83**	**80.83**

Advanced Geometry Swagelok Size 4; .035 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	20	40	55	70	90
2	25	40	55	70	80
3	20	40	55	70	80
4	25	40	60	80	95
5	25	45	65	80	100
6	25	45	75	90	100
No. Samples:	6	6	6	6	6
Largest:	25.00	45.00	75.00	90.00	100.00
Smallest:	20.00	40.00	55.00	70.00	80.00
Variation:	5	5	20	20	20
Average:	**23**	**42**	**61**	**77**	**91**

A-LOK Size 4; .035 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	35	75	110	140	185
2	30	60	85	115	145
3	30	60	85	110	140
4	35	80	100	120	145
5	20	50	75	100	130
6	40	90	140	200	230
7	40	70	105	145	190
8	35	90	120	170	210
9	40	80	120	185	230
10	40	100	130	160	200
11	40	60	90	110	140
12	30	60	90	110	140
13	30	65	85	105	140
14	35	50	75	95	115
15	30	65	10	120	170
16	35	80	110	150	200
17	40	90	110	150	190
18	35	60	90	120	155
19	30	50	80	105	140
20	30	70	110	140	170
No. Samples:	20	20	20	20	20
Largest:	40.00	100.00	140.00	200.00	230.00
Smallest:	20.00	50.00	10.00	35.00	115.00
Variation:	20.00	50.00	130.00	105.00	115.00
Average:	**34.00**	**70.25**	**93.00**	**132.50**	**168.25**

Duolok Size 4; .065 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	16	38	56	80	120
2	20	40	60	85	120
3	20	45	65	95	130
4	18	46	60	70	110
5	15	30	45	77	100
6	20	45	60	85	130
7	25	52	65	90	128
8	20	40	58	65	115
9	20	45	60	80	120
10	25	45	65	85	135
11	20	40	55	70	125
12	20	35	55	70	105
13	20	45	55	70	100
14	20	40	60	75	130
15	20	40	60	80	120
16	20	40	58	80	110
17	20	40	55	65	105
18	20	40	55	65	100
19	20	40	55	75	120
20	20	40	55	75	115
No. Samples:	20	20	20	20	20
Largest:	25.00	52.00	65.00	35.00	135.00
Smallest:	15.00	30.00	45.00	65.00	100.00
Variation:	10.00	22.00	20.00	30.00	35.00
Average:	**19.95**	**41.30**	**57.85**	**76.85**	**116.90**

A-LOK Size 4; .065 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	20	80	135	200	280
2	30	65	90	120	160
3	40	110	160	230	270
4	30	70	100	120	160
5	40	85	115	150	200
6	30	70	100	135	185
7	20	60	90	115	170
8	40	110	170	230	280
9	35	100	150	210	280
10	35	75	100	130	180
11	30	65	100	140	200
12	20	70	100	140	200
13	25	60	95	120	140
14	40	110	210	330	380
15	30	80	120	200	290
16	30	70	90	100	150
17	30	80	105	150	240
18	30	100	140	180	240
19	35	90	115	155	210
20	30	90	140	200	260
No. Samples:	20	20	20	20	20
Largest:	40.00	110.00	210.00	330.00	380.00
Smallest:	20.00	60.00	90.00	100.00	140.00
Variation:	20.00	50.00	120.00	230.00	240.00
Average:	**31.00**	**82.00**	**121.25**	**167.75**	**223.75**

Original Swagelok Size 4; .065 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	18	45	65	90	125
2	23	46	62	80	110
3	23	45	64	100	150
4	19	42	64	95	140
5	21	44	60	100	135
6	19	42	64	105	140
7	22	46	66	90	135
8	21	45	64	80	105
9	22	43	58	80	110
10	17	38	54	85	110
11	18	37	54	70	115
12	20	40	55	75	120
13	19	40	60	80	120
14	15	35	52	70	100
15	15	37	54	80	115
16	21	49	70	120	150
17	18	42	57	90	125
18	22	51	72	90	130
19	21	46	62	100	145
20	17	38	55	75	120
No. Samples:	20	20	20	20	20
Largest:	23.00	51.00	72.00	120.00	150.00
Smallest:	15.00	35.00	52.00	70.00	100.00
Variation:	8.00	16.00	20.00	50.00	50.00
Average:	**19.55**	**42.55**	**60.60**	**87.75**	**125.00**

Advanced Geometry Swagelok Size 4; .065 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	35	75	100	130	150
2	30	60	70	110	120
3	30	65	90	110	125
4	30	70	110	135	150
5	35	90	150	160	170
6	40	65	100	135	140
No. Samples:	6	6	6	6	6
Largest:	40.00	90.00	150.00	160.00	170.00
Smallest:	30.00	60.00	70.00	110.00	120.00
Variation:	10	30	80	50	50
Average:	**33**	**71**	**103**	**130**	**143**

Duolok Size 6; .035 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	25	45	60	85	145
2	25	40	60	80	115
3	25	40	55	75	125
4	25	45	60	90	130
5	30	50	70	95	125
6	25	40	60	80	120
7	25	50	75	100	150
8	40	70	90	115	170
9	25	45	60	90	130
10	30	40	55	90	150
11	30	50	70	100	165
12	30	45	60	100	155
13	30	55	70	100	155
14	25	45	60	80	125
15	25	45	65	90	110
16	30	45	60	75	140
17	30	45	55	80	125
18	30	45	55	90	125
19	30	45	65	85	140
20	30	50	65	90	130
No. Samples:	20	20	20	20	20
Largest:	40.00	70.00	90.00	115.00	170.00
Smallest:	25.00	40.00	55.00	75.00	110.00
Variation:	15.00	30.00	35.00	40.00	60.00
Average:	38.25	46.75	63.50	895.00	136.50

A-LOK Size 6; .035 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	50	90	120	200	270
2	50	90	130	190	250
3	50	85	100	160	220
4	45	80	130	200	250
5	45	80	120	170	230
6	60	105	145	195	260
7	50	110	175	205	260
8	60	90	150	200	275
9	45	85	125	200	275
10	50	95	140	200	245
11	45	85	145	210	270
12	50	90	105	155	205
13	50	100	130	200	260
14	60	90	135	185	250
15	60	100	165	230	300
16	45	90	110	150	225
17	60	100	155	210	300
18	50	90	140	195	250
19	50	95	150	190	245
20	45	100	145	200	260
No. Samples:	20	20	20	20	20
Largest:	60.00	110.00	175.00	230.00	300.00
Smallest:	45.00	80.00	100.00	150.00	205.00
Variation:	15.00	30.00	75.00	80.00	35.00
Average:	51.00	92.50	135.75	192.25	255.00

Original Swagelok Size 6; .035 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	40	70	115	130	152
2	40	70	105	150	190
3	30	50	90	115	145
4	30	50	70	90	120
5	30	50	65	120	150
6	50	80	125	150	190
7	35	65	100	140	175
8	30	50	90	110	140
9	40	55	90	140	185
10	30	50	95	105	135
11	35	70	120	140	150
12	40	55	95	135	155
13	30	50	90	125	160
14	30	50	105	140	165
15	30	65	90	140	195
16	35	50	80	120	150
17	30	55	95	130	160
18	50	85	140	200	280
19	35	60	95	130	170
20	35	50	75	100	135
No. Samples:	20	20	20	20	20
Largest:	50.00	85.00	140.00	200.00	280.00
Smallest:	30.00	50.00	65.00	90.00	120.00
Variation:	20.00	35.00	75.00	110.00	160.00
Average:	35.25	59.00	96.50	130.50	165.10

Advanced Geometry Swagelok Size 6; .035 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	30	55	80	130	180
2	30	50	80	120	155
3	25	50	75	120	150
4	30	50	70	115	150
5	30	50	65	110	140
6	30	50	80	125	145
7	30	45	80	120	155
8	30	50	85	160	175
9	35	55	75	130	150
10	35	45	75	120	150
11	25	40	80	155	165
12	35	45	90	135	150
13	35	65	90	170	190
14	20	60	85	170	180
15	40	55	90	150	160
16	35	60	100	140	155
17	35	60	90	160	170
18	40	60	85	155	170
19	30	65	100	170	175
20	35	60	80	150	190
No. Samples:	20	20	20	20	20
Largest:	40.00	20.00	65.00	100.00	170.00
Smallest:	20.00	40.00	65.00	110.00	140.00
Variation:	20	25	35	60	50
Average:	32	54	83	140	163

Duolok Size 6; .065 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	30	70	90	145	225
2	20	55	80	140	220
3	25	60	80	135	200
4	20	65	100	155	240
5	20	50	80	110	170
6	40	60	80	125	200
7	35	65	105	180	250
8	30	70	90	160	220
9	20	60	80	110	190
10	25	65	100	170	265
11	20	60	85	140	215
12	20	60	85	150	230
13	30	75	100	150	235
14	25	65	95	160	230
15	30	70	95	145	225
16	20	60	85	160	240
17	25	55	80	150	200
18	20	60	90	140	215
19	20	50	75	105	170
20	20	55	80	150	200
No. Samples:	20	20	20	20	20
Largest:	40.00	75.00	105.00	180.00	265.00
Smallest:	20.00	50.00	75.00	150.00	170.00
Variation:	20.00	25.00	30.00	75.00	95.00
Average:	24.75	61.50	87.75	144.00	217.00

A-LOK Size 6; .065 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	60	120	160	220	330
2	90	160	185	200	280
3	50	115	150	220	300
4	70	110	140	165	240
5	45	110	140	210	300
6	65	110	140	180	280
7	60	115	170	245	330
8	60	130	180	220	300
9	80	130	175	220	320
10	65	110	150	195	280
No. Samples:	10	10	10	10	10
Largest:	90.00	160.00	185.00	245.00	330.00
Smallest:	45.00	110.00	140.00	165.00	240.00
Variation:	45.00	50.00	45.00	80.00	90.00
Average:	64.50	121.00	159.00	207.50	296.00

Original Swagelok Size 6; .065 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	30	80	140	190	230
2	30	90	130	170	220
3	30	70	115	160	200
4	40	70	90	120	160
5	30	70	110	180	225
6	30	80	100	150	210
7	50	90	140	210	300
8	40	70	95	130	200
9	40	110	170	230	285
10	40	90	130	170	215
11	40	70	105	160	230
12	50	90	120	165	230
13	60	110	150	200	235
14	30	80	100	140	180
15	40	80	135	200	250
16	40	120	200	320	415
17	50	100	135	205	260
18	80	195	285	360	480
19	60	150	195	290	350
20	50	90	135	170	220
No. Samples:	20	20	20	20	20
Largest:	80.00	195.00	285.00	360.00	480.00
Smallest:	30.00	70.00	90.00	120.00	160.00
Variation:	50.00	125.00	195.00	240.00	320.00
Average:	43.00	95.25	139.00	196.00	254.75

Advanced Geometry Swagelok Size 6; .065 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	35	80	150	200	235
2	30	80	155	200	210
3	25	80	120	170	190
4	35	85	130	180	190
5	20	50	80	160	180
6	40	75	155	200	210
7	40	75	140	190	200
8	40	75	155	205	210
9	45	85	160	185	200
10	20	65	150	190	200
11	45	60	110	170	190
12	30	60	145	190	200
13	40	65	130	160	180
14	35	70	140	200	210
15	35	70	145	180	195
16	40	75	150	190	205
17	35	80	125	195	210
18	40	80	130	180	190
19	40	85	150	210	215
20	55	90	150	205	220
No. Samples:	20	20	20	20	20
Largest:	55.00	90.00	160.00	210.00	235.00
Smallest:	20.00	50.00	80.00	160.00	180.00
Variation:	35	40	80	50	55
Average:	36	74	139	188	202

Duolok Size 8; .035 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	30	60	100	115	160
2	30	70	110	145	200
3	35	70	140	160	220
4	40	65	100	140	205
5	30	55	95	175	220
6	30	65	110	155	210
7	35	70	100	165	240
8	40	70	115	160	230
9	30	75	125	170	220
10	30	50	75	175	190
11	40	70	95	140	210
12	40	100	140	205	260
13	35	80	110	170	230
14	30	60	100	150	200
15	30	60	90	145	200
16	30	60	90	150	210
17	40	75	140	200	250
18	45	70	120	175	230
19	40	70	95	140	170
20	40	75	100	140	210
No. Samples:	20	20	20	20	20
Largest:	45.00	100.00	140.00	205.00	260.00
Smallest:	30.00	50.00	75.00	115.00	160.00
Variation:	15.00	50.00	65.00	90.00	100.00
Average:	**35.00**	**68.50**	**170.50**	**158.75**	**213.25**

A-LOK Size 8; .035 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	65	165	275	350	450
2	55	165	275	340	400
3	45	160	265	325	400
4	50	130	190	290	340
5	50	150	260	360	450
6	60	170	250	330	380
7	50	150	230	290	330
8	50	130	230	290	360
9	60	180	270	370	410
10	50	110	170	240	340
11	50	120	190	270	335
12	60	130	250	360	450
13	70	150	240	300	370
14	50	140	230	300	390
15	70	170	250	340	430
16	50	100	170	240	290
17	60	170	250	380	470
18	40	120	190	270	340
19	50	110	180	270	330
20	60	130	210	320	400
No. Samples:	20	20	20	20	20
Largest:	70.00	180.00	275.00	380.00	470.00
Smallest:	40.00	100.00	170.00	240.00	290.00
Variation:	30.00	80.00	105.00	140.00	180.00
Average:	**54.75**	**142.50**	**228.95**	**311.75**	**383.25**

Advanced Geometry Swagelok Size 8; .035 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	45	80	115	160	210
2	40	85	150	170	200
3	45	80	120	160	200
4	50	90	180	210	290
5	50	90	130	150	170
6	40	90	180	210	270
7	50	80	170	200	230
8	40	80	150	180	210
9	50	130	200	255	340
10	40	100	150	180	210
11	30	85	150	180	220
12	35	100	135	170	205
13	45	90	140	160	190
14	40	70	135	170	190
15	40	100	150	170	195
16	40	110	160	180	220
17	40	110	175	220	290
18	50	85	130	170	200
19	45	85	150	185	205
20	40	90	140	170	205
No. Samples:	20	20	20	20	20
Largest:	50.00	130.00	200.00	255.00	340.00
Smallest:	30.00	70.00	115.00	150.00	170.00
Variation:	20.00	60.00	85.00	105.00	170.00
Average:	**43**	**92**	**151**	**183**	**223**

Duolok Size 8; .049 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	55	100	130	175	240
2	70	120	200	250	315
3	45	70	110	125	165
4	50	80	110	135	180
5	50	85	115	135	200
6	45	60	110	125	190
7	45	80	100	120	160
8	30	80	90	125	200
9	40	80	100	120	140
10	50	85	100	125	165
No. Samples:	10	10	10	10	10
Largest:	70	120	200	250	315
Smallest:	30	60	90	120	140
Variation:	40	60	110	130	175
Average:	**48**	**84**	**117**	**144**	**196**

A-LOK Size 8; .049 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	120	180	240	300	360
2	120	240	300	420	480
3	180	240	360	420	540
4	180	240	300	360	420
5	60	180	240	300	336
6	84	180	240	300	396
7	84	180	240	324	432
8	84	180	240	300	396
9	60	180	264	324	396
10	60	180	240	300	372
11	84	180	276	300	360
12	120	240	360	420	480
13	60	180	240	300	372
14	84	180	276	348	420
15	96	180	240	300	372
16	108	216	300	384	480
17	60	120	228	300	384
18	108	300	384	480	600
19	108	216	300	348	420
20	72	180	288	336	420
No. Samples:	20	20	20	20	20
Largest:	180.00	300.00	384.00	480.00	600.00
Smallest:	60.00	120.00	228.00	300.00	360.00
Variation:	120.00	180.00	156.00	180.00	240.00
Average:	**96.60**	**198.60**	**277.80**	**343.20**	**424.80**

Advanced Geometry Swagelok Size 8; .049 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	70	190	270	290	350
2	60	100	150	170	200
3	70	150	200	250	330
4	70	160	250	280	310
5	70	110	190	260	350
6	60	140	240	270	330
No. Samples:	6	6	6	6	6
Largest:	70.00	190.00	270.00	290.00	350.00
Smallest:	60.00	100.00	150.00	170.00	200.00
Variation:	10.00	90.00	120.00	120.00	150.00
Average:	**67**	**142**	**217**	**251**	**312**

Duolok Size 8; .083 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	30	100	150	215	280
2	30	110	160	220	370
3	25	100	130	200	300
4	20	100	125	205	310
5	20	90	140	160	270
6	25	105	180	250	340
7	30	110	140	185	270
8	25	105	190	245	370
9	35	100	130	175	285
10	35	95	120	165	280
No. Samples:	10	10	10	10	10
Largest:	35	110	190	250	370
Smallest:	20	90	120	160	270
Variation:	15	20	70	90	100
Average:	28	102	147	202	308

A-LOK Size 8; .083 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	100	200	275	420	575
2	80	190	260	350	520
3	70	185	260	365	540
4	90	190	255	370	515
5	100	220	320	430	610
6	135	250	380	425	560
7	110	250	390	480	650
8	110	260	380	510	680
9	35	80	130	190	270
10	100	190	300	420	600
11	130	280	350	450	650
12	100	200	295	405	600
13	90	180	270	360	560
14	110	220	320	420	640
15	110	230	320	420	580
16	110	210	300	430	610
17	100	240	360	485	700
18	100	250	380	510	620
19	110	220	310	400	610
20	150	330	440	600	780
No. Samples:	20	20	20	20	20
Largest:	150.00	330.00	440.00	600.00	780.00
Smallest:	35.00	80.00	130.00	190.00	270.00
Variation:	115.00	250.00	310.00	410.00	510.00
Average:	102.00	218.75	315.75	422.00	593.50

Original Swagelok Size 8; .083 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	35	75	110	140	185
2	30	60	85	115	145
3	30	60	85	110	140
4	35	80	100	120	145
5	20	50	75	100	130
6	40	90	140	200	230
7	40	70	105	145	190
8	35	90	120	170	210
9	40	80	120	185	230
10	40	100	130	160	200
11	40	60	90	110	140
12	30	60	90	110	140
13	30	65	85	105	140
14	35	50	75	95	115
15	30	65	10	120	170
16	35	80	110	150	200
17	40	90	110	150	190
18	35	60	90	120	155
19	30	50	80	105	140
20	30	70	110	140	170
No. Samples:	20	20	20	20	20
Largest:	40.00	100.00	140.00	200.00	230.00
Smallest:	20.00	50.00	10.00	95.00	115.00
Variation:	20.00	50.00	130.00	105.00	115.00
Average:	34.00	70.25	96.00	132.50	168.25

Advanced Geometry Swagelok Size84; .083 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	50	200	255	355	415
2	45	170	230	330	410
3	25	170	220	320	390
4	30	125	210	280	340
5	35	155	220	290	340
6	30	155	190	270	355
7	40	145	225	325	370
8	35	145	210	295	415
9	40	150	200	305	340
10	40	165	215	310	350
11	50	150	200	245	340
12	50	210	285	360	445
13	55	165	210	255	345
14	45	180	210	270	345
15	60	220	290	390	500
16	50	160	210	270	340
17	60	160	225	285	390
18	40	160	205	260	370
19	50	170	285	380	525
20	45	130	210	260	370
No. Samples:	20	20	20	20	20
Largest:	60.00	220.00	290.00	390.00	525.00
Smallest:	25.00	125.00	190.00	245.00	340.00
Variation:	35.00	95.00	100.00	145.00	185.00
Average:	44	164	225	303	385

Duolok Size 12; .049 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	5	13	21	28	38
2	5	15	22	35	42
3	5	15	23	37	55
4	5	15	25	43	50
No. Samples:	4	4	4	4	4
Largest:	5.42	15.00	25.00	42.50	55.00
Smallest:	4.58	13.33	20.83	28.33	38.33
Variation:	0.83	1.67	4.17	14.17	16.67
Average:	**5.00**	**14.38**	**22.50**	**35.63**	**46.25**

A-LOK Size 12; .049 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	8	25	36	50	62
2	11	21	32	42	56
3	7	14	22	32	42
4	7	21	35	46	63
5	14	28	35	48	60
6	7	18	28	35	49
7	10	21	35	42	49
8	10	20	28	35	42
9	10	21	35	42	70
10	14	35	46	53	67
11	10	21	35	39	49
12	7	14	24	36	56
13	11	35	53	56	63
14	7	25	38	50	56
15	7	21	35	39	50
16	7	20	31	35	45
17	7	21	31	35	57
18	14	35	56	70	91
19	7	24	24	28	35
20	7	35	35	49	77
No. Samples:	20	20	20	20	20
Largest:	14.01	35.03	56.05	70.06	91.08
Smallest:	7.01	14.01	22.42	28.02	35.03
Variation:	7.01	21.02	33.63	42.04	56.05
Average:	**9.11**	**23.75**	**34.75**	**43.23**	**57.03**

Advanced Geinetry Swagelok Size 12; .049 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	5	23	46	50	60
2	6	18	42	57	62
3	5	21	33	43	47
4	10	25	40	65	70
5	10	25	35	70	75
6	10	20	50	70	80
No. Samples:	6	6	6	6	6
Largest:	10.00	25.00	50.00	70.00	80.00
Smallest:	5.00	17.92	32.50	42.50	47.08
Variation:	5.00	7.08	17.50	27.50	32.92
Average:	**8**	**22**	**41**	**59**	**66**

Duolok Size 12; .065 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	10	15	25	30	50
2	5	15	25	30	40
3	10	15	25	35	50
4	5	15	25	30	45
5	5	15	25	35	55
6	5	15	20	30	45
No. Samples:	6	6	6	6	6
Largest:	10.00	15.00	25.00	35.00	55.00
Smallest:	5.00	15.00	20.00	30.00	40.00
Variation:	5.00	0.00	5.00	5.00	15.00
Average:	**6.67**	**15.00**	**24.17**	**31.67**	**47.50**

A-LOK Size 12; .065 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	18	33	50	60	78
2	20	30	50	65	80
3	10	20	30	50	70
4	10	25	30	50	65
5	15	30	40	50	70
6	15	30	45	55	75
No. Samples:	6	6	6	6	6
Largest:	20.00	33.00	50.00	65.00	80.00
Smallest:	10.00	20.00	30.00	50.00	65.00
Variation:	10.00	13.00	20.00	15.00	15.00
Average:	**14.67**	**28.00**	**40.83**	**55.00**	**73.00**

Advanced Geometry Swagelok Size 12; .065 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	10	30	45	55	70
2	10	30	50	60	70
3	10	30	45	50	65
4	10	30	50	65	80
5	10	35	55	65	75
6	10	25	45	50	60
No. Samples:	6	6	6	6	6
Largest:	10.00	35.00	55.00	65.00	80.00
Smallest:	10.00	25.00	45.00	50.00	60.00
Variation:	0.00	10.00	10.00	15.00	20.00
Average:	**10**	**30**	**48**	**58**	**70**

Duolok Size 12; .109 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	7	18	28	43	62
2	9	25	34	49	68
3	5	18	25	35	55
4	6	18	25	35	50
No. Samples:	4	4	4	4	4
Largest:	9.17	25.00	34.17	49.17	68.00
Smallest:	5.42	17.50	25.00	35.00	50.00
Variation:	3.75	7.50	9.17	14.17	18.00
Average:	**6.77**	**19.69**	**28.23**	**40.52**	**58.75**

Advanced Geometry Swagelok Size 12; .109 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	7	27	39	47	63
2	9	30	38	48	65
3	11	28	45	57	70
4	10	15	40	55	75
5	10	25	55	65	75
6	7	15	35	55	60
No. Samples:	6	6	6	6	6
Largest:	10.83	29.58	55.00	65.00	75.00
Smallest:	6.67	15.00	35.00	47.08	60.00
Variation:	4.17	14.58	20.00	17.92	15.00
Average:	**9**	**23**	**42**	**55**	**68**

A-LOK Size 12; .109 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	7	21	42	49	77
2	14	28	42	56	91
3	7	21	35	56	77
4	7	21	35	49	77
5	14	35	49	63	105
6	7	28	49	60	94
7	7	35	49	63	105
8	11	35	49	70	105
9	14	35	42	49	77
10	21	49	77	98	119
11	14	28	42	70	112
12	7	28	39	49	77
13	7	21	35	46	77
14	7	21	42	49	81
15	14	28	42	63	95
16	7	21	35	42	81
17	7	32	49	63	95
18	7	25	38	49	76
19	11	35	56	70	88
20	14	42	56	70	91
No. Samples:	20	20	20	20	20
Largest:	21.02	49.04	77.07	98.08	119.10
Smallest:	7.01	21.02	35.03	42.04	75.66
Variation:	1.01	28.02	42.04	56.05	43.44
Average:	**10.23**	**29.50**	**45.19**	**59.27**	**90.10**

Duolok Size 16; .065 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	19	44	63	88	113
2	16	38	63	82	122
3	19	38	63	69	88
4	19	48	69	88	126
5	6	19	44	63	82
6	6	23	40	60	69
7	6	25	44	60	82
8	6	25	44	57	75
9	13	25	50	63	88
10	13	31	44	57	88
11	6	25	45	63	93
12	13	25	44	57	88
13	6	31	63	88	107
14	13	25	38	57	82
15	6	25	57	67	90
16	6	19	44	63	82
17	6	25	50	63	88
18	6	25	44	63	88
19	6	29	44	50	69
20	13	31	50	63	94
21	9	31	50	69	93
22	6	25	53	79	113
23	6	25	50	75	94
24	6	23	40	57	79
25	6	29	50	60	82
26	6	23	53	57	82
27	6	31	53	73	88
28	6	25	57	75	98
29	6	31	53	73	94
30	6	25	44	63	79
31	6	31	63	75	97
32	9	31	50	63	82
33	13	31	57	75	113
34	13	38	69	88	126
35	15	44	75	94	119
36	19	44	63	88	113
37	10	25	40	64	112
38	10	22	40	60	110
39	10	20	45	75	130
40	10	20	40	60	100
41	10	25	50	72	120
42	10	25	45	70	125
43	10	20	30	45	75
44	10	25	45	75	130
45	10	20	35	55	90
46	10	20	35	55	80
No. Samples:	46	46	46	46	46
Largest:	19	48	75	94	130
Smallest:	6	19	35	45	69
Variation:	4	7	10	11	17
Average:	**10**	**28**	**50**	**68**	**96**

A-LOK Size 16; .065 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	13	44	63	107	138
2	13	38	63	88	100
3	13	38	69	100	176
4	13	38	63	88	113
5	13	38	63	82	107
6	13	50	88	126	163
7	13	38	69	88	113
8	13	44	75	100	126
9	13	31	63	88	126
10	13	38	75	113	151
11	13	38	63	100	132
12	13	50	75	107	163
13	13	31	57	88	113
14	13	31	50	69	94
15	13	31	63	100	126
16	13	38	63	94	113
17	13	31	57	75	107
18	13	38	69	94	113
19	13	38	69	94	126
20	13	38	69	100	119
No. Samples:	20	20	20	20	20
Largest:	12.56	50.24	89.92	125.60	175.84
Smallest:	12.56	31.40	50.24	69.08	94.20
Variation:	0.00	18.84	37.68	56.52	82.64
Average:	**12.56**	**37.99**	**6.25**	**95.14**	**125.91**

Advanced Geometry Swagelok Size 16; .065 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	10	35	65	85	100
2	10	30	65	95	125
3	10	30	65	100	135
No. Samples:	3	3	3	3	3
Largest:	10.00	35.00	65.00	100.00	135.00
Smallest:	10.00	30.00	65.00	85.00	100.00
Variation:	0.00	5.00	0.00	15.00	35.00
Average:	**10**	**32**	**65**	**90**	**120**

Duolok Size 16; .120 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	25	43	62	85	138
2	30	48	69	88	126
3	25	50	67	97	147
4	31	63	100	126	163
5	13	31	57	69	107
6	13	38	63	82	100
7	13	25	44	57	82
8	15	44	63	75	112
9	13	25	50	82	119
10	19	38	50	88	163
11	19	44	69	94	126
12	15	38	75	88	100
13	13	31	50	75	94
14	19	50	82	107	157
15	13	44	57	82	100
16	19	34	54	63	88
17	6	31	50	69	100
18	6	44	69	100	188
19	13	44	82	126	214
20	13	31	53	63	100
21	19	44	75	100	195
22	13	38	57	63	88
23	16	38	57	75	100
24	13	40	63	69	100
25	19	38	57	82	113
26	13	38	63	79	107
27	13	31	57	63	94
28	25	57	75	113	163
29	31	57	63	88	126
30	25	44	69	94	144
31	25	50	75	100	188
32	25	38	57	88	113
33	31	50	69	94	126
34	25	38	57	75	100
35	25	38	44	63	82
36	31	50	75	94	144
37	31	57	88	132	163
38	25	38	50	69	94
39	19	38	50	75	94
40	25	38	57	94	126
41	38	63	82	119	195
42	38	50	69	88	119
43	25	38	57	82	107
44	29	44	63	82	107
45	31	50	63	82	119
46	50	69	138	188	232
47	69	119	151	182	220
48	31	63	94	134	201
49	63	94	113	182	251
50	31	63	94	107	170
51	25	57	82	113	176
52	38	69	107	144	226
53	38	63	88	132	176
54	31	57	69	82	119
55	38	63	88	157	220
No. Samples:	55	55	55	55	55
Largest:	69	119	151	188	232
Smallest:	6	25	44	57	82
Variation:	12	16	21	31	45
Average:	**25**	**48**	**70**	**96**	**139**

A-LOK Size 16; .120 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	13	63	107	157	201
2	13	63	100	138	214
3	13	63	100	132	188
4	19	44	69	107	132
5	19	50	82	113	163
6	19	57	88	126	188
7	19	44	69	107	132
8	19	50	75	107	144
9	19	50	75	126	163
10	19	50	107	126	163
11	19	63	107	132	220
12	19	50	88	119	201
13	19	50	94	132	170
14	19	38	75	107	132
15	25	63	100	132	207
16	31	63	94	126	195
17	25	50	72	113	144
18	19	44	75	100	138
19	13	38	69	100	119
20	13	44	63	88	100
No. Samples:	20	20	20	20	20
Largest:	31.40	62.80	106.76	157.00	219.80
Smallest:	12.56	37.48	62.80	87.92	100.48
Variation:	18.84	25.12	43.96	69.08	119.32
Average:	**18.53**	**51.83**	**86.04**	**119.32**	**165.79**

Advanced Geometry Swagelok Size 16; .120 Wall					
Sam No.	0.25	0.5	0.75	1	1.25
1	10	35	75	95	125
2	10	30	65	90	120
3	10	40	70	105	155
No. Samples:	3	3	3	3	3
Largest:	10.00	40.00	75.00	105.00	155.00
Smallest:	10.00	30.00	65.00	90.00	120.00
Variation:	0.00	10.00	10.00	15.00	35.00
Average:	**10**	**35**	**70**	**97**	**133**

C. EQUIPMENT

Validation Test Equipment	
Test Description	**Test Equipment Description**
Initial Make-Up Test	CDI 0-600 in lb torque wrench
	D3-250FR 0-250 ft lb torque wrench

Table 5.0.C.1

SSP Document Number: ILETR120202 Rev. -

NOTICE: This publication is an uncontrolled copy of a controlled document. SSP has made every reasonable effort to insure the accuracy of the information contained in this publication, and is not to be held liable in any manner for any mistakes, omissions, typographical and/or printing errors.